Oroville Facilities Relicensing Operations Modeling Seminar

June 24, 2003

Seminar Agenda

- Welcome and Introduction – Patti Kroen/Curtis Creel
- Operations Modeling Basics
- Operations Model Applications
- Q&A (Panel Discussion)
- Lunch
- Operations Modeling Tools
- Next Steps

Seminar Purpose and Objectives

- Understand why we are modeling and how the results will assist in relicensing
- Understand the operations modeling process and coordination
- Understand technical issues of interest related to operations modeling

Participation Principles

- Participate – Attend the Seminar
- Learn – Learn about resources, people, roles, and process
- Represent – Bring issues and interests forward from others whose interests you share
- Cooperate – Work with others in the Seminar to share information and consider options
- Educate – Report back to others who share your interests

Seminar Ground Rules

- Commit to Being Fully Present
  - No cell phones, pagers, voicemail, etc.
  - Ask for what you need from the seminar and participants
- Honor Our Time Limits
  - Keep comments and discussion concise
  - Stay focused on the topic – Use the parking lot for other issues
- Respect Each Other
  - Listen carefully to other participants
  - Respond to ideas and issues, not individuals
- Support Constructive Discussion
  - Suggest improvements and solutions
  - Build on others' ideas – Use "and" instead of "but"

Seminar Agenda

9:00	• Welcome and Introduction – Patti Kroen/Curtis Creel	
9:10	• Operations Modeling Basics	Curtis Creel Yung-Hsin Sun Bill Smith
	• Operations Model Applications	
10:10	• Break	
10:25	• Operations Model Application (cont'd)	
11:15	• Q&A (Panel Discussion)	
11:45ish	• Lunch	
12:15	• Operations Modeling Tools –	Erik Reyes Tung Van Do Carl Chen Eric Clyde
4:15	• Next Steps	

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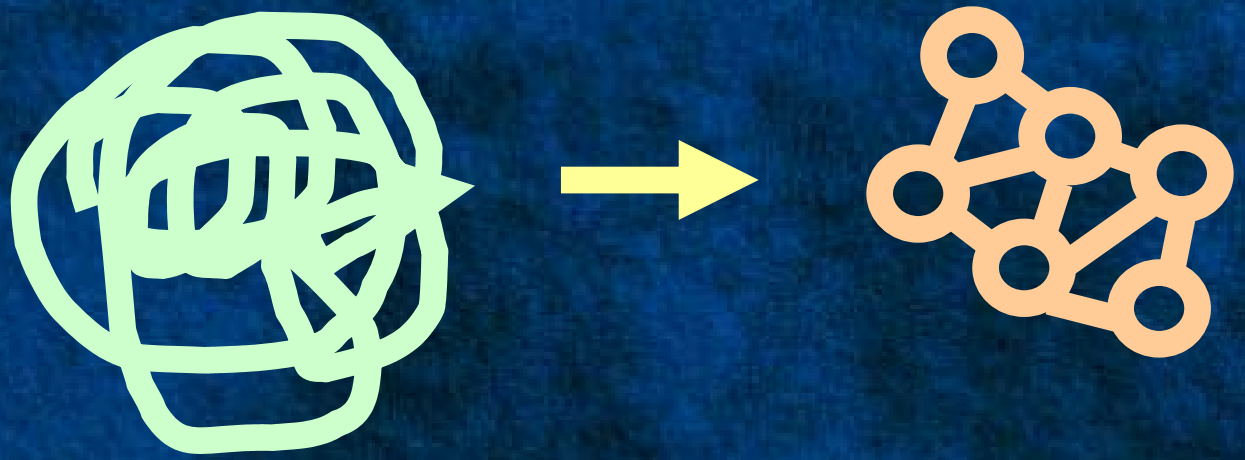
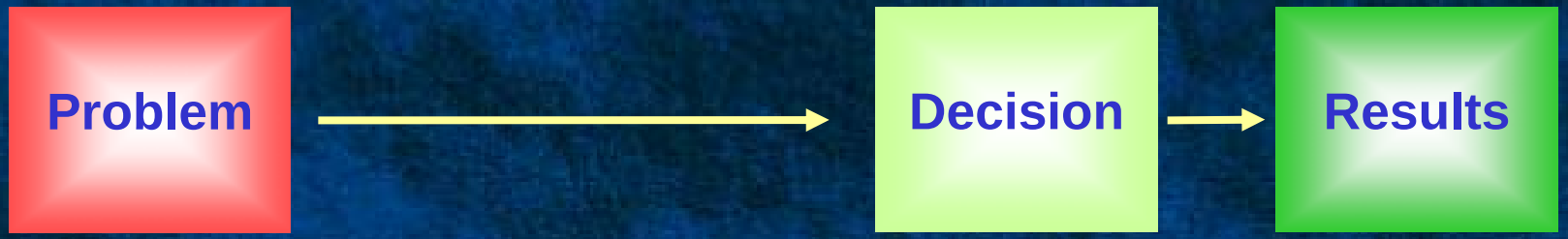
What Is a Model?

- Model *n.* A system of postulates, data, and inferences presented as a mathematical description of an entity or state of affairs (Merriam-Webster's Collegiate Dictionary)

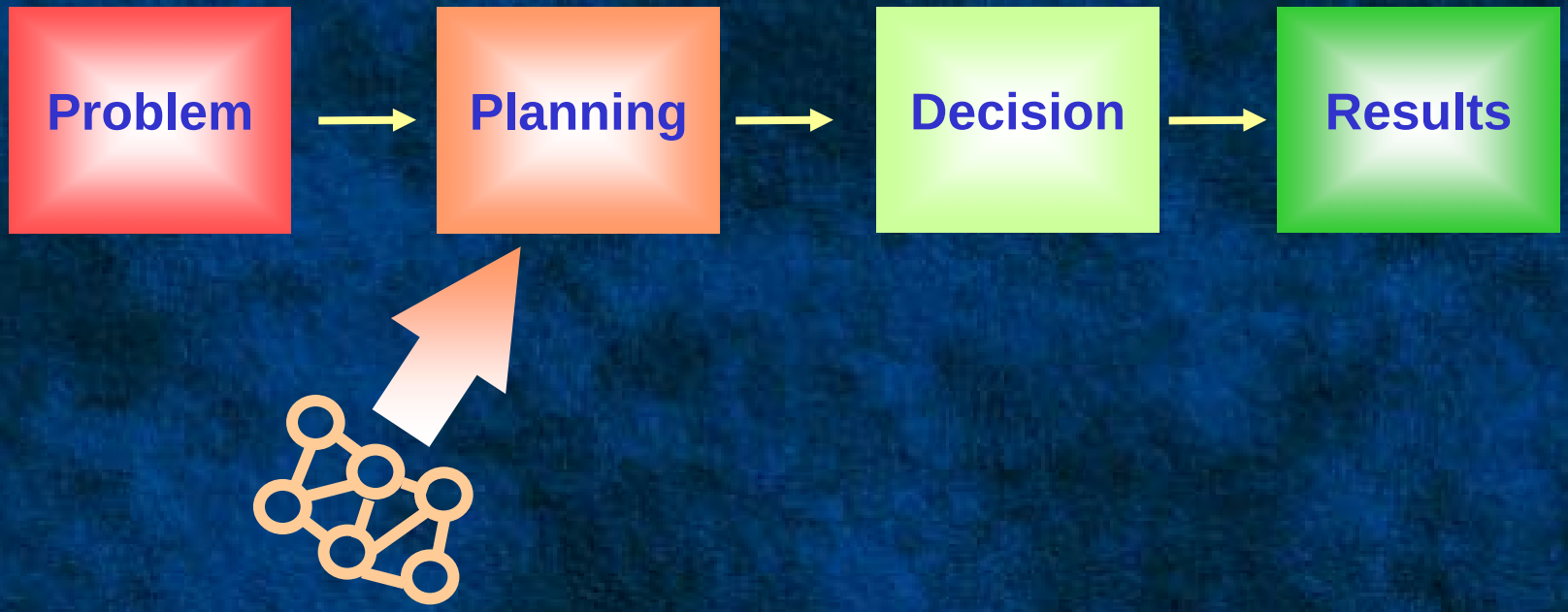


Why Do We Use Models?



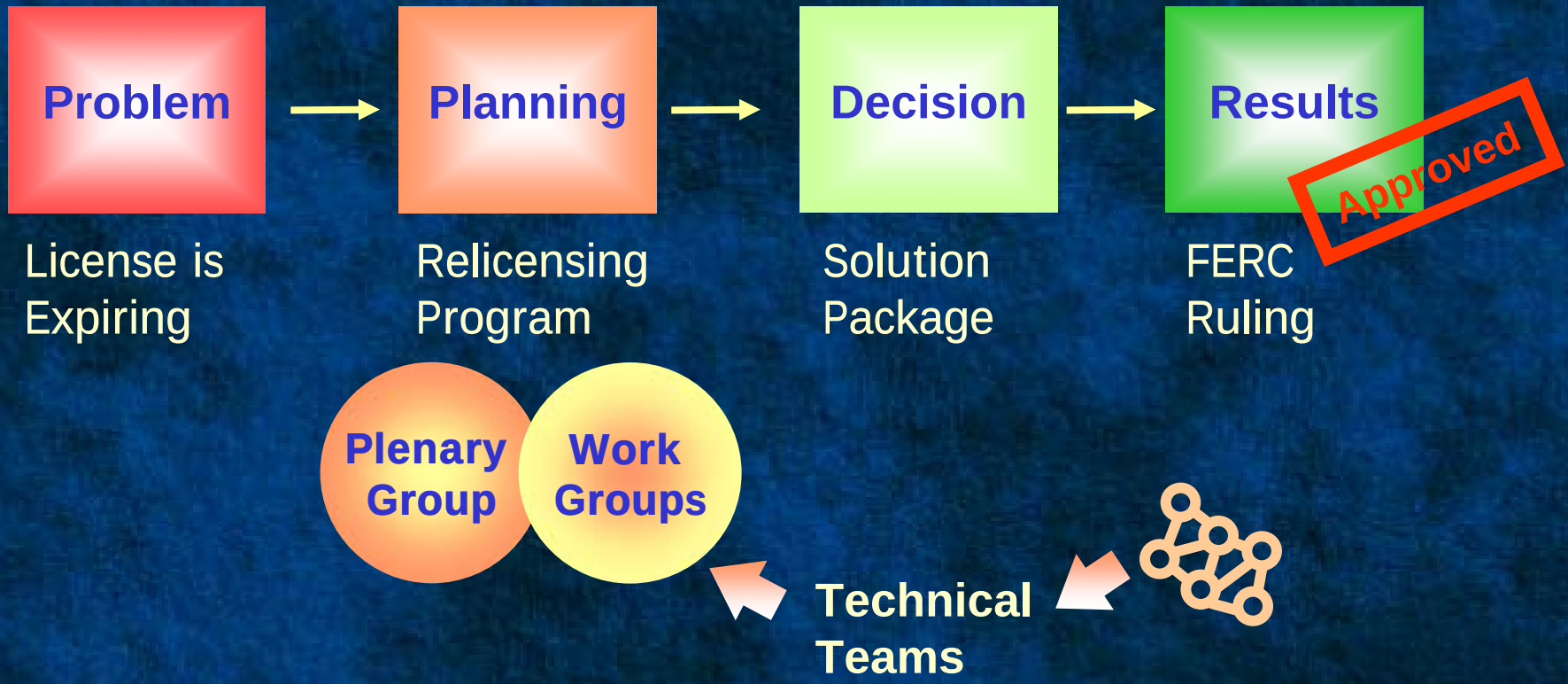
Why Do We Use Models?

- Model is used to answer “What if?”



Why Do We Use Models?

- Oroville Facilities Relicensing



Operations Modeling Suite

CALSIM II

HYDROPS

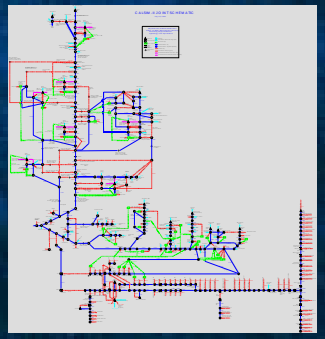
WQRRS

HEC-RAS

Operations Modeling Suite

CALSIM II | **HYDROPS** | **WQRRS** | **HEC-RAS**

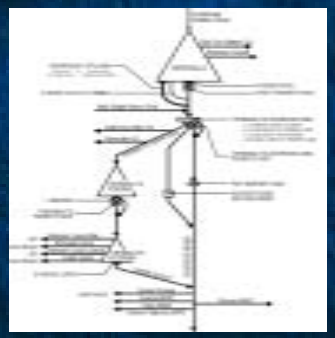
- Statewide CVP/SWP operations model
- Monthly time-step
- Simulate water supply for 73 years
- Subject to
  - Historical hydrology with synthetic upstream impairments
  - Constant “level of development”
  - Existing laws, regulations, policies, contracts, etc.
- Results
  - Water supply conditions
  - Water budget used by HYDROPS



Operations Modeling Suite

CALSIM II | **HYDROPS** | WQRRS | HEC-RAS

- Local operations model for Oroville Facilities operations
- Hourly time-step
- Simulate power generation on a weekly basis
- Subject to
  - Water budgets from CALSIM II
  - Facility operation constraints and criteria
- Results
  - Flow conditions and power generation
  - Operational scenario used by WQRRS



Operations Modeling Suite

CALSIM II | HYDROPS | **WQRRS** | HEC-RAS

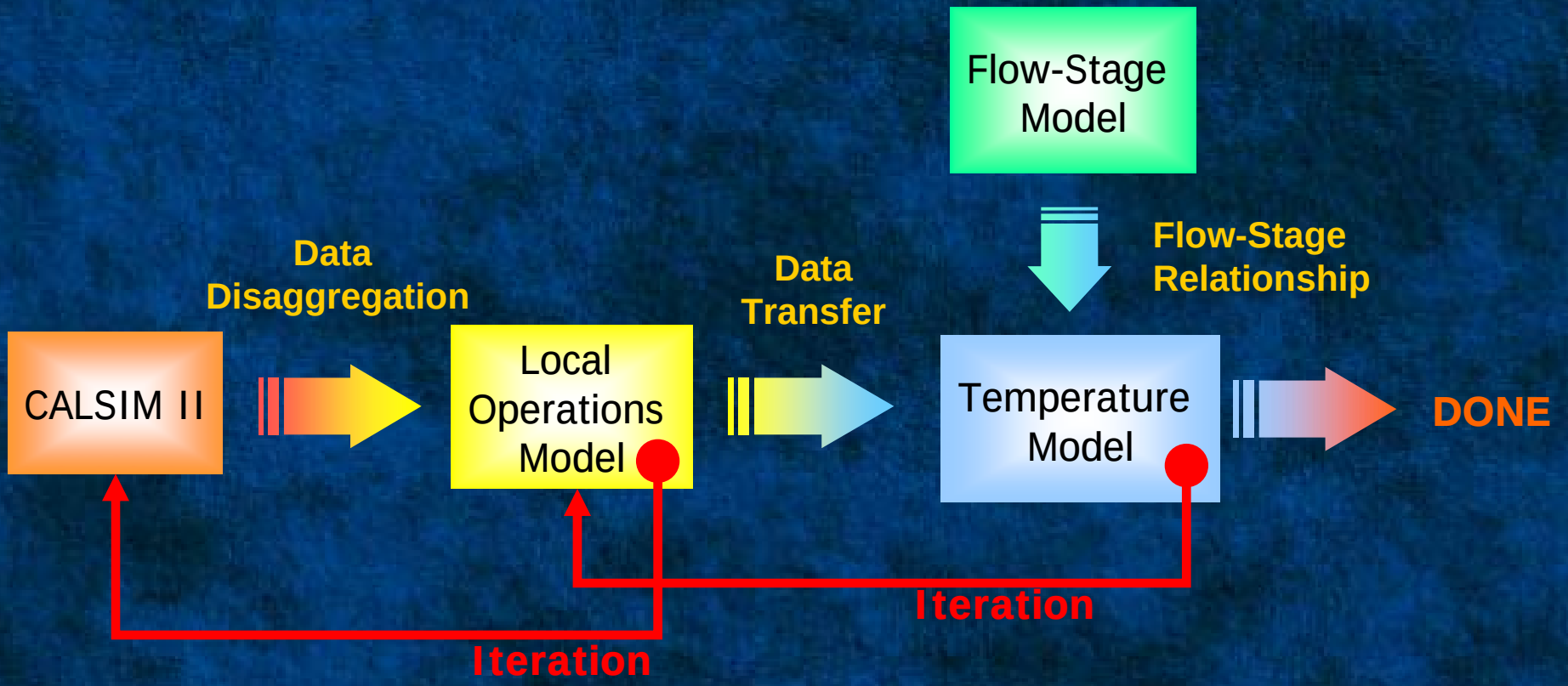
- Temperature model for Oroville Facilities and Feather River
- Hourly time-step
- Simulate reservoir and river temperatures for a given operational scenario
- Results
  - Reservoir and river temperature conditions
  - Indications of potential operational changes

Operations Modeling Suite

CALSIM II | HYDROPS | WQRRS | HEC-RAS

- Flow-stage model for Feather River below Oroville Dam to the confluence of the Sacramento River
- Cross section every ¼-mile
- Generate flow-stage relationship at a given location
- Focus on lower flow conditions (i.e., non-flooding conditions)
- Results
  - Static, unless changes in channel configuration
  - Flow-stage relationship used by WQRRS and other environmental studies

Operations Modeling Suite

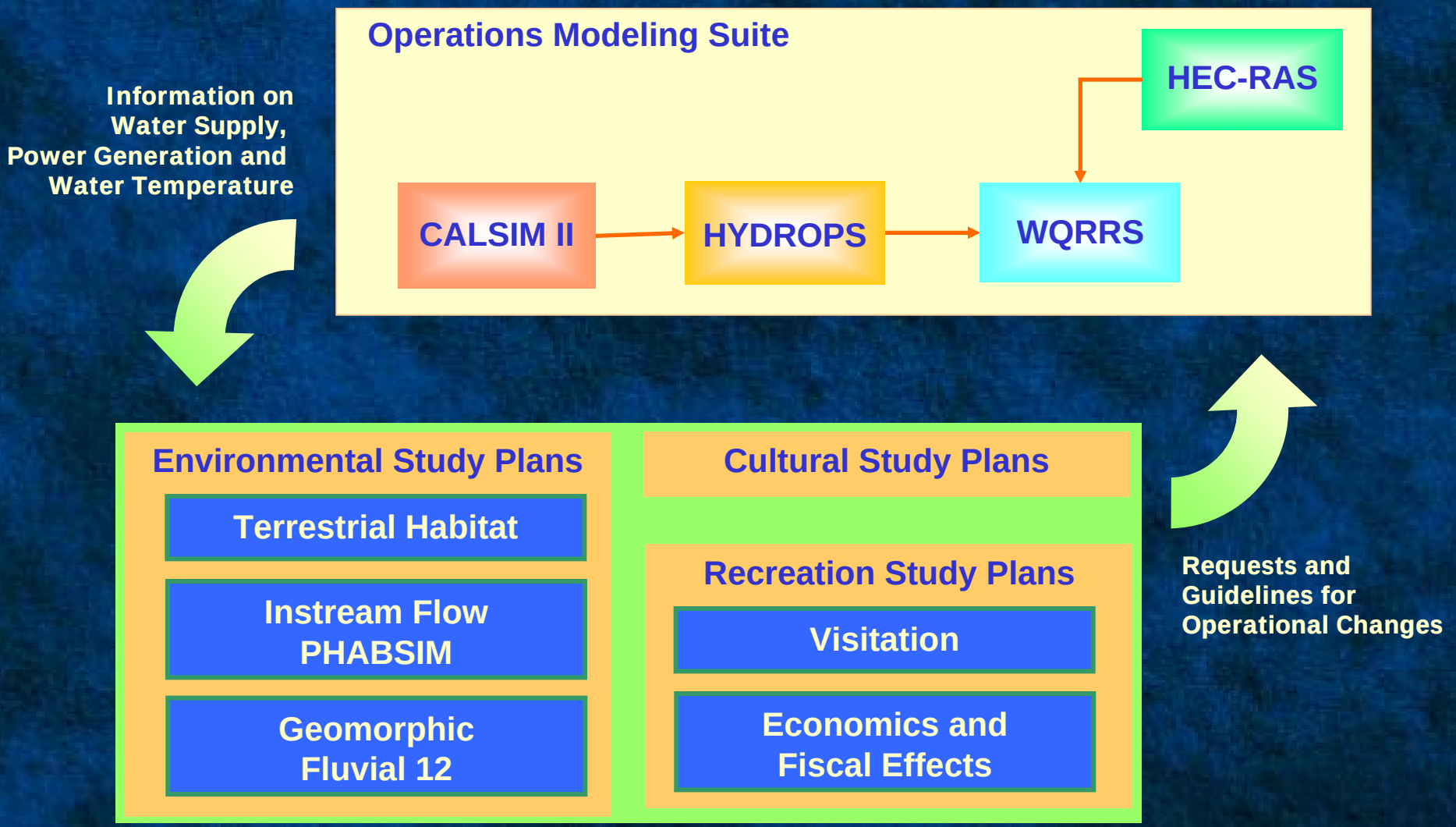


- Water supply conditions
- Monthly operations and water budget

- Power generation
- Hourly operations

- Reservoir temperature
- River temperature

Relicensing Model Integration



Modeling Data Exchange

- **HUGE** amount of data

- Data exchange among models (Existing as a big happy family)
  - Monthly vs. Weekly vs. Hourly
  - Different input/output format and definition
- Data exchange beyond models (Connecting to the world)
  - Study team access and applications
  - Public access and review

Seminar Agenda

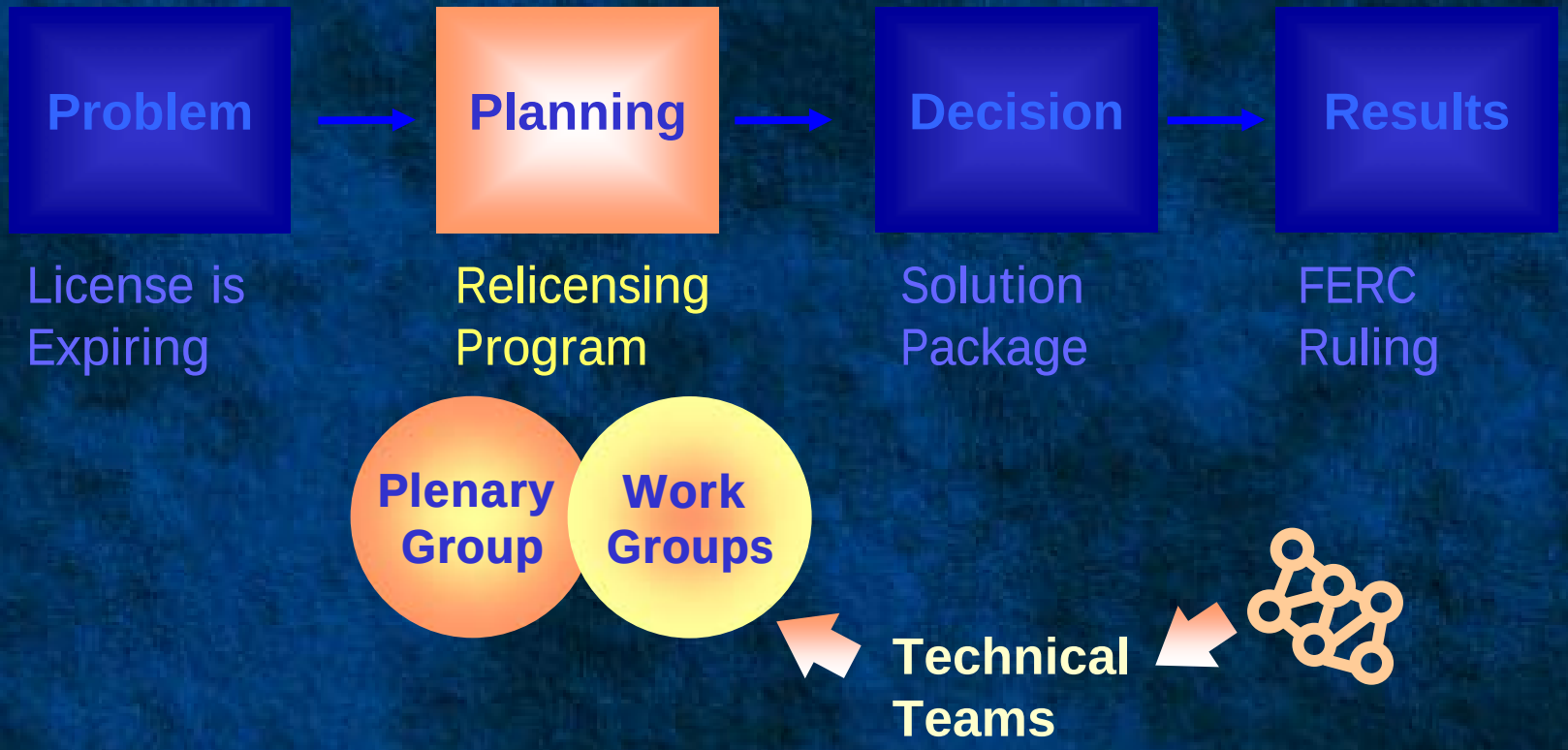
- Welcome and Introduction
- Operations Modeling Basics
- Model Applications
  - Matching modeling purposes
  - Getting right information
  - Managing modeling efforts
- Q&A
- Lunch
- Operations Modeling Tools
- Next Steps

Matching Modeling Purposes

- "All models are wrong, but some are useful." - George Box, Professor, U. Wisconsin
- “Entities should not be multiplied unnecessarily.” - 14th century logician William of Occam
  - **Law of Parsimony**
- Albert Einstein,
  - "Make your theory as simple as possible, but no simpler."
  - "For every complex question there is a simple and wrong solution."

Matching Modeling Purposes

- Planning studies for Oroville Facilities Relicensing Program



Matching Modeling Purposes

- Planning vs. Forecasting
  - Different focus
    - Planning: relationship between causes and consequences
    - Forecasting: accuracy
  - Different criteria
    - Planning: reasonableness
    - Forecasting: accuracy

Matching Modeling Purposes

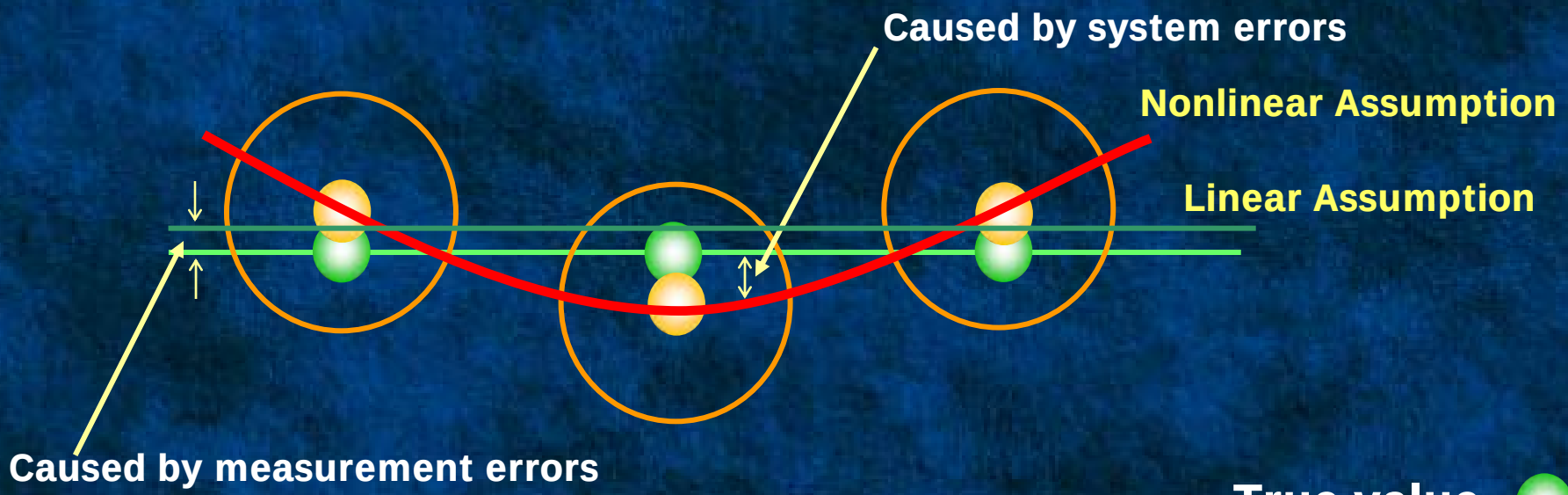
- Planning vs. Real-time Operations
  - Different level of risk management
    - Planning: long-term
    - Real-time: short- and/or near-term
  - Different criteria
    - Planning: trends
    - Real-time: avoiding jail time

Getting Right Information

- Modeling Errors
  - System errors: Assumptions on how the system works
  - Observation (measurement) errors: Data used to calibrate the model, built on the above assumptions, for its application

Getting Right Information

- Most of the time, both errors exist!



NOT TO SCALE

Getting Right Information

- Recognizing the Imperfect Modeling World
  - Common Sense Led Us to the Moon
  - Minimizing Potential System Errors
- Minimizing Impacts of Modeling Errors on Decision-Making
  - Focus on Reasonableness and Trends
  - Infer from Relative Changes between Scenarios
  - Consider Significance of the Relative Changes in a Real-World Sense
  - Look Past Unsupported Model Precision

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- Welcome and Introduction
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- Operations Model Applications
  - Managing Modeling Efforts
- Q&A (Panel Discussion)
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Managing Modeling Efforts

- Operations Modeling Request (a Complete One)
  - Resource Action based objective(s)
  - Criteria and constraints
  - Measurement(s) of accomplishment
- Modeling Plan
  - Modeling tools and requirements
  - Potential decision points for modification
- Responsible Party
  - Operations Modeling Coordinator

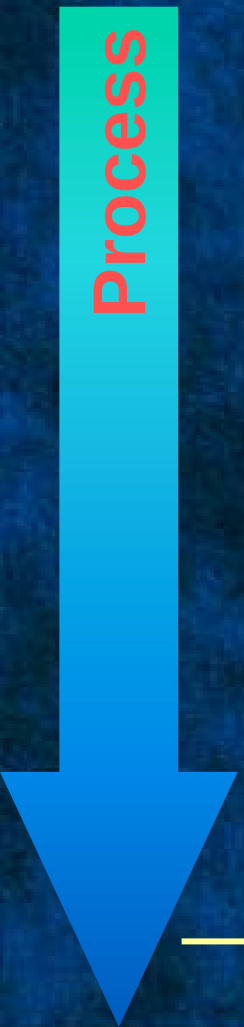
Fearless Leader

Managing Modeling Efforts

- Operations Modeling Coordinator
- Working closely with requestor(s) and operations modeling team
- Responsibilities
  - Coordinate model development
  - Prioritize modeling requests
  - Match modeling requests with operation standards and criteria
  - Coordinate model implementation
  - Ensure exchange of right information

Hi, I am Curtis Creel

Managing Modeling Efforts



	Requestor(s)	Operations Coordinator	Modeling Team Members
Request Initiation	●	●	
Modeling Plan Development / Modification	●	●	●
Modeling Plan Implementation		●	●
Results Reviewed by Team			
Results Reviewed by Requestor(s)			
Request Addressed			

Managing Modeling Efforts

	Requestor(s)	Operations Coordinator	Modeling Team Members
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Managing Modeling Efforts

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Request Initiation			
Modeling Plan Development / Modification	●	●	●
Modeling Plan Implementation		●	●
Results Reviewed by Team		●	●
Results Reviewed by Requestor(s)	●	●	●
Request Addressed			

Managing Modeling Efforts

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Request Addressed			

Process

Managing Modeling Efforts

- Prioritizing Among Requests
  - Critical to relicensing program
  - Completeness of the request
  - Physical/legal/policy feasibility of proposed operational changes
  - Work load of team members
- Consolidating Requests
  - Finding common ground
  - Using representative conditions

Managing Modeling Efforts

- Results of Managing Modeling Efforts
  - Address more requests
  - Support relicensing program more effectively
  - Provide quicker turnaround time
- An Example for Illustrative Purposes

Seminar Agenda

- Welcome and Introduction
- Operations Modeling Basics
- Operations Model Applications
  - Example
- Q&A (Panel Discussion)
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- Next Steps

Example: Request for Analysis

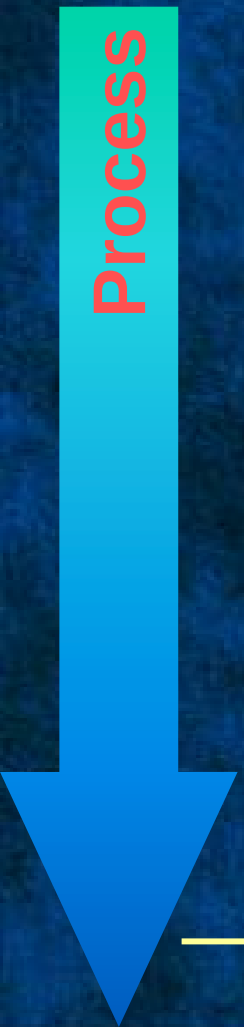
	Requestor(s)	Operations Coordinator	Modeling Team Members
Request Initiation	●	●	
Modeling Plan Development / Modification			
Modeling Plan Implementation			
Results Reviewed by Team			
Results Reviewed by Requestor(s)			
Request Addressed			

Process

Example: Request for Analysis

- Description of Resource Action to Analyze
  - Operate the Oroville Facilities in a manner to minimize the warming of water released to the Feather River.
  - Too vague, need specifics
- Work with requestor for clarity

Example: Develop Modeling Plan



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Request Initiation	●	●	
Modeling Plan Development / Modification	●	●	●
Modeling Plan Implementation			
Results Reviewed by Team			
Results Reviewed by Requestor(s)			
Request Addressed			

Example: Request for analysis

- Description of resource action to analyze
- Work with requestor for clarity
  - Maintain water temperature at river mile “x” below “y” degrees.
  - Y is a function of time
  - Y is a target

Example: Develop Modeling Plan

	Requestor(s)	Operations Coordinator	Modeling Team Members
Request Initiation			
Modeling Plan Development / Modification		●	●
Modeling Plan Implementation			
Results Reviewed by Team			
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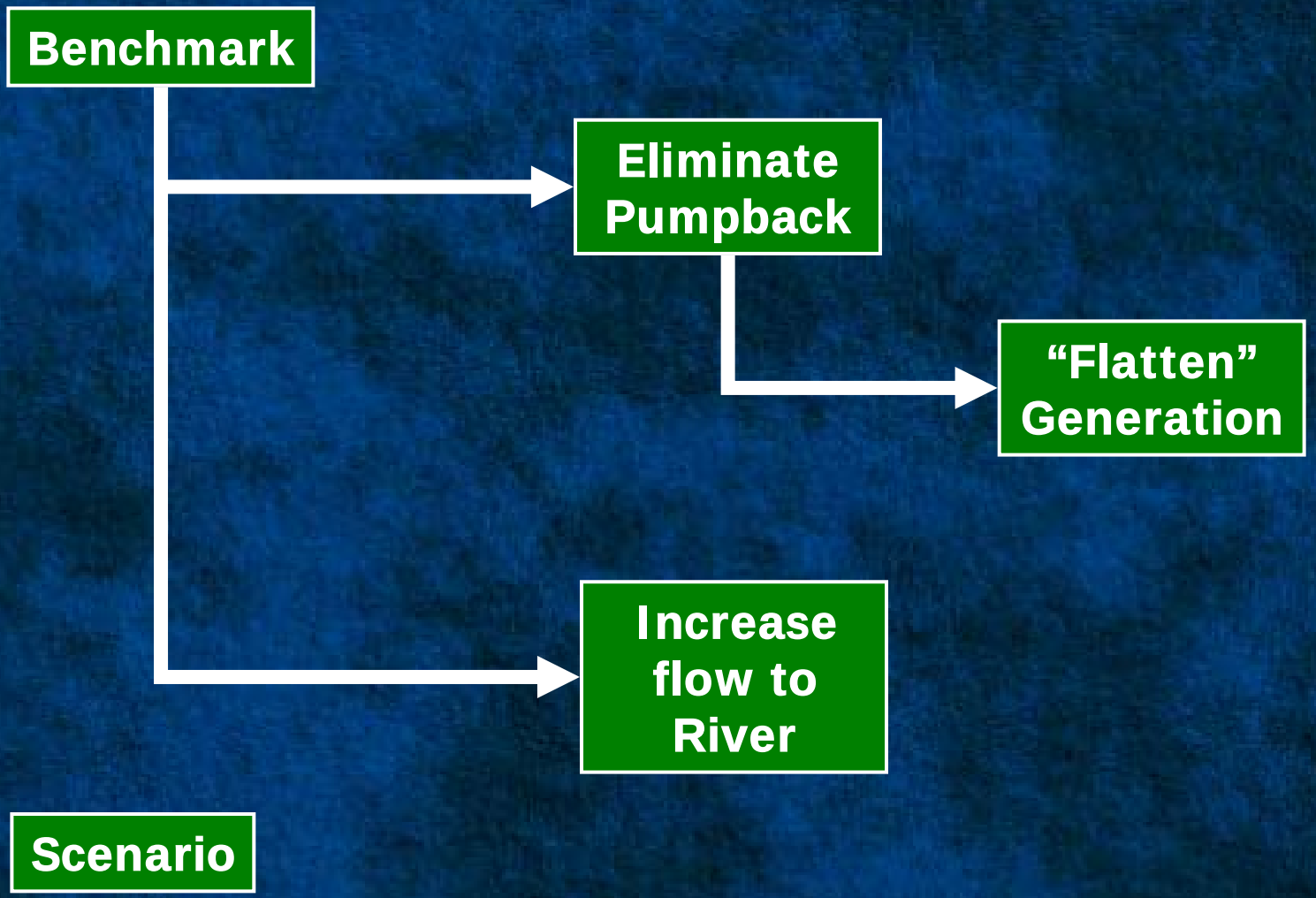
Request Addressed			

Process

Example: Develop Model Plan

- Are there existing scenarios that can be analyzed?
  - Side Bar: What is a “scenario”?
  - A specific set of conditions, rules, or assumptions to model.

Examples of Scenarios



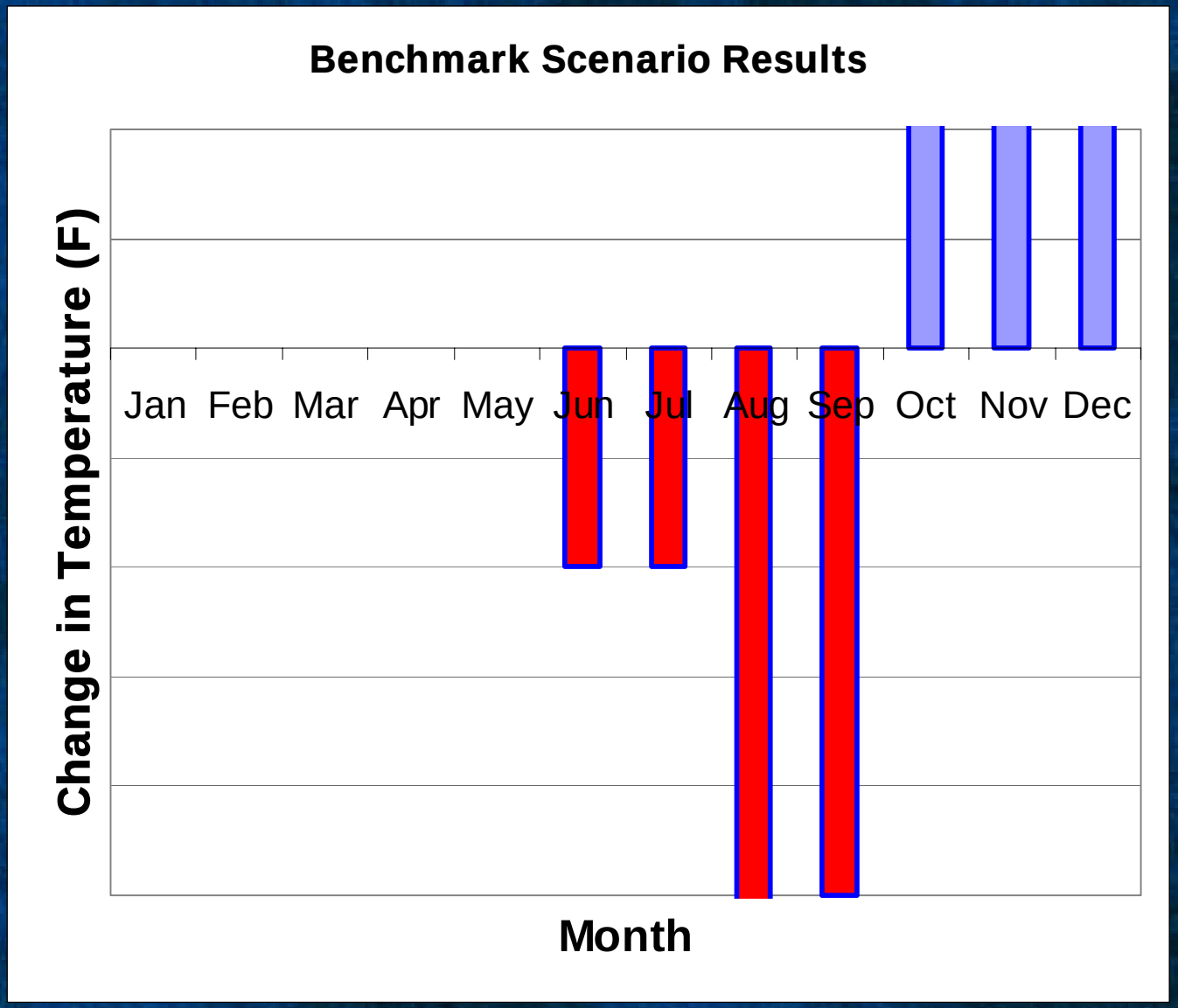
Example: Develop Model Plan

- Are there existing scenarios that can be analyzed?
  - Benchmark Scenarios
- What are the assumptions used for the analysis?

Example: Analysis Assumptions

- Cannot control temperature at the location exactly due to response time, intermediate heat gain prediction accuracy, etc.
- From previous work we know we need about a 1 degree “buffer” to ensure we do not exceed the temperature
- Agree to use target one degree below requirement for modeling

Example:


Benchmark Scenario Results
Change in Temperature (F)
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Month

Example: Develop Model Plan

- Are there existing scenarios that can be analyzed?
  - Benchmark Scenarios
  - Yes, but we need at least another

Example: Develop Model Plan

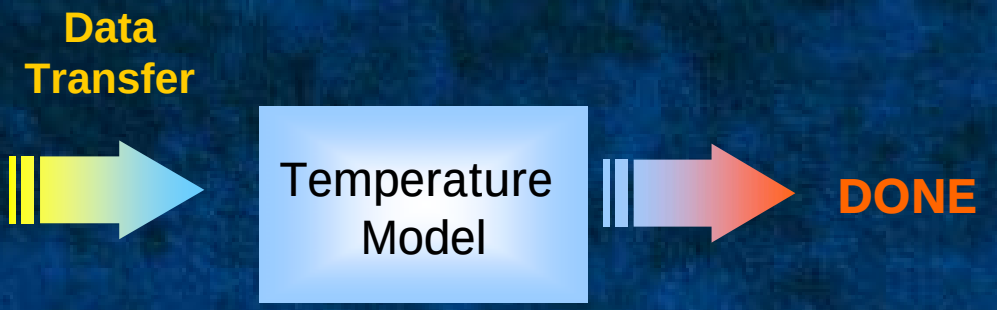
- Are there existing scenarios that can be analyzed?
- Develop a scenario to model
  - Strategy
  - Models that will be used
  - Modeling Assumptions

Example: Strategy to Achieve Target

- Three things we can do...
  - Reduce the Temperature of Oroville releases
  - Re-operate Oroville Facilities to increase low flow channel releases and decrease flow through Thermalito Powerplant
  - Increase Oroville Facilities release volume

Example: Models to use

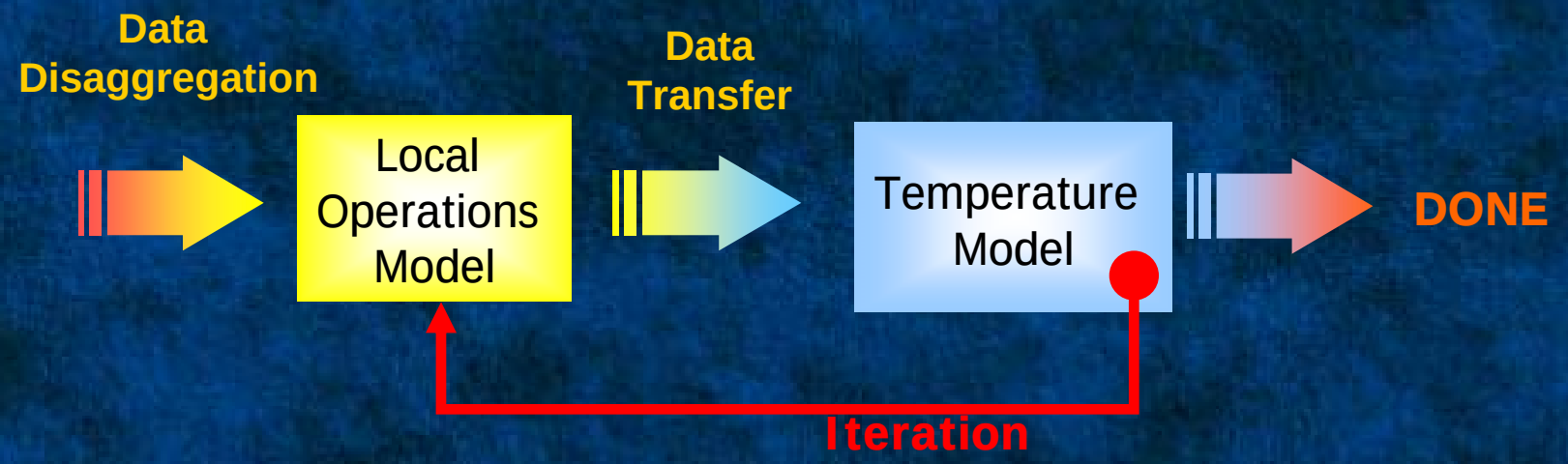
- Reduce Oroville Facilities release temperature
  - Just run Temperature Model



- **Reservoir temperature**
- **River temperature**

Example: Models to use

- Reduce Oroville release temperature
  - Also use the river outlet valves



- Power generation
- Hourly operations

- Reservoir temperature
- River temperature

Example: Review initial results

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Request Initiation			
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Results Reviewed by Team		●	●
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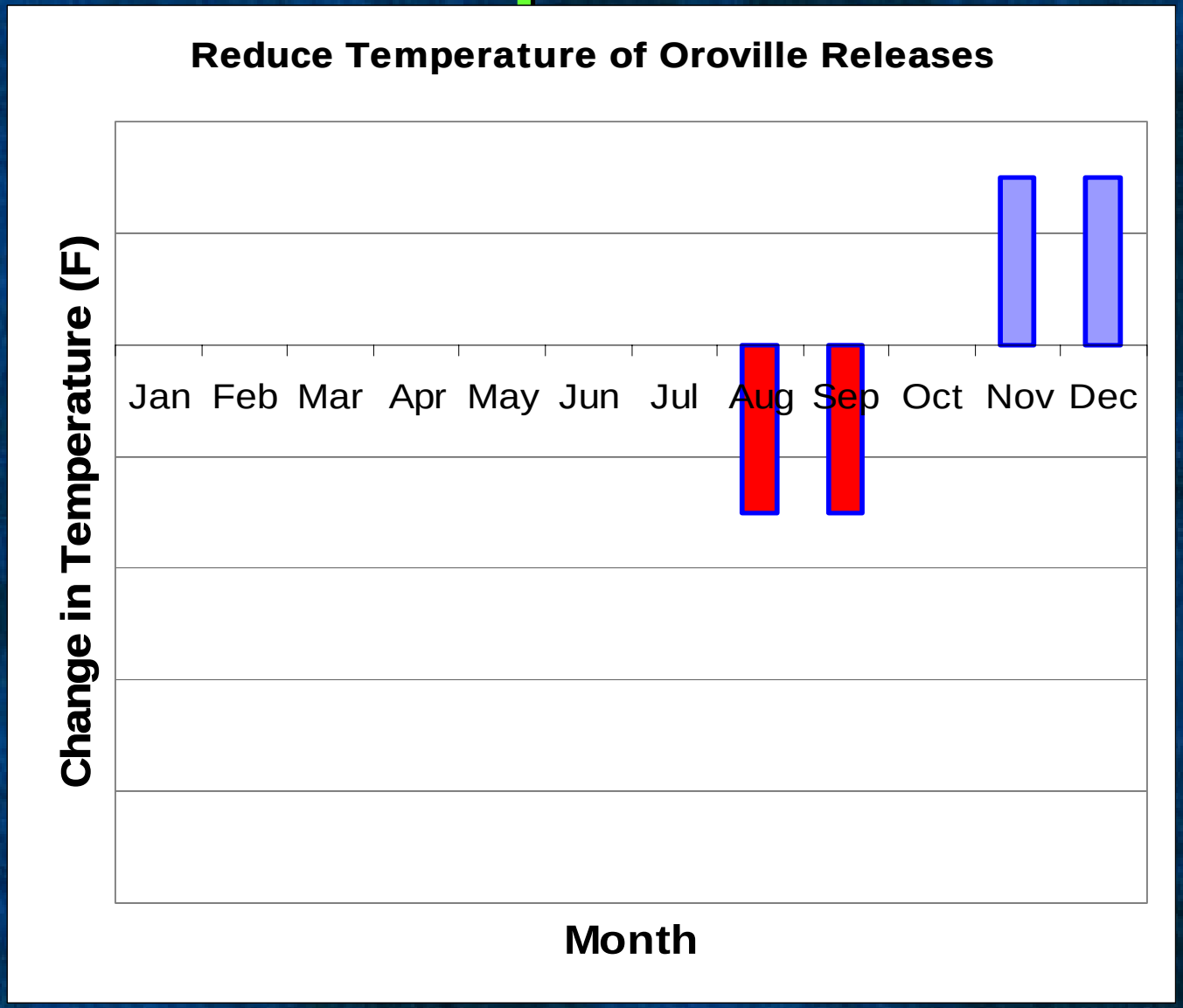
Request Addressed			

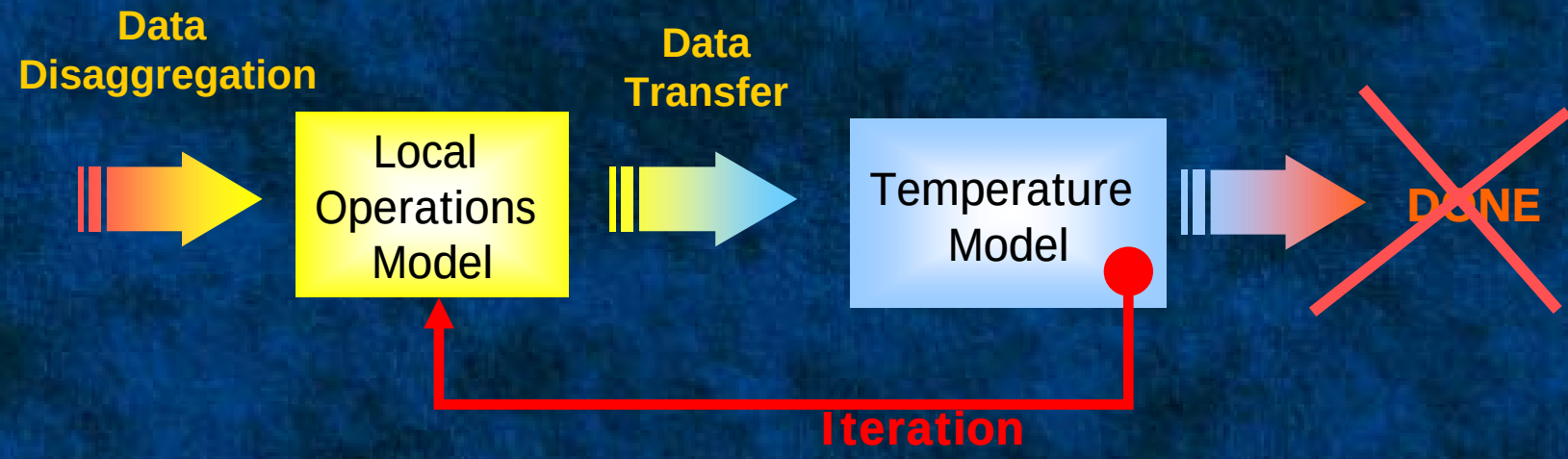
Process

Example: Scenario to reduce release temperatures



Example: Models to use

- Reduce Oroville release temperature
  - Also use the river outlet valves

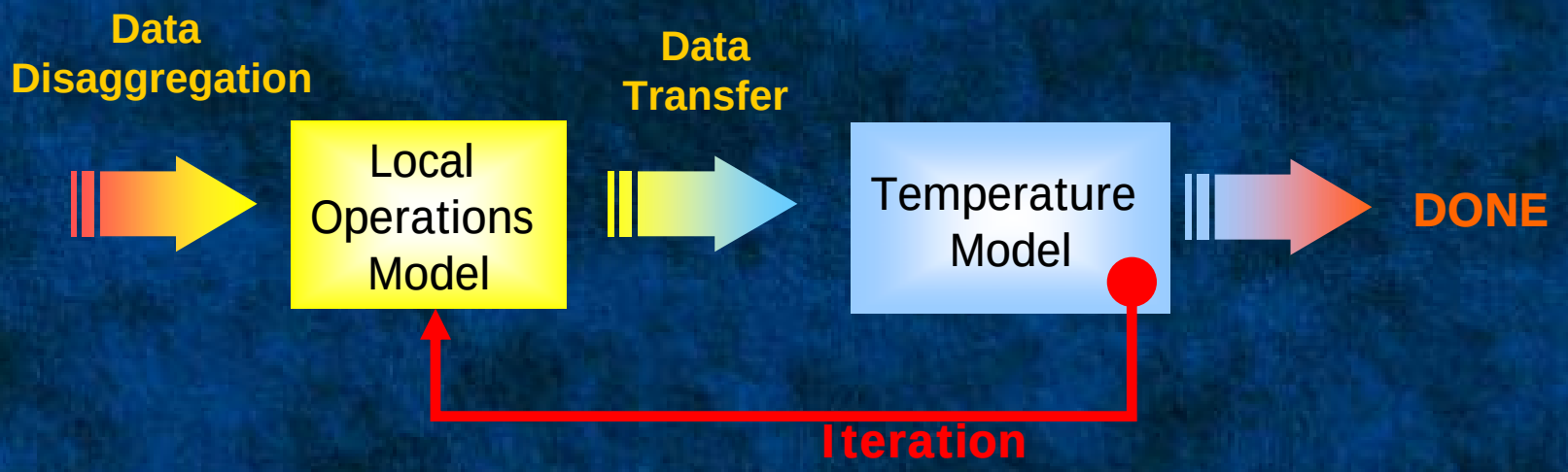


- Power generation
- Hourly operations

- Reservoir temperature
- River temperature

Example: Models to use

- Re-operate Thermalito Powerplant
  - Increase releases to the low flow channel



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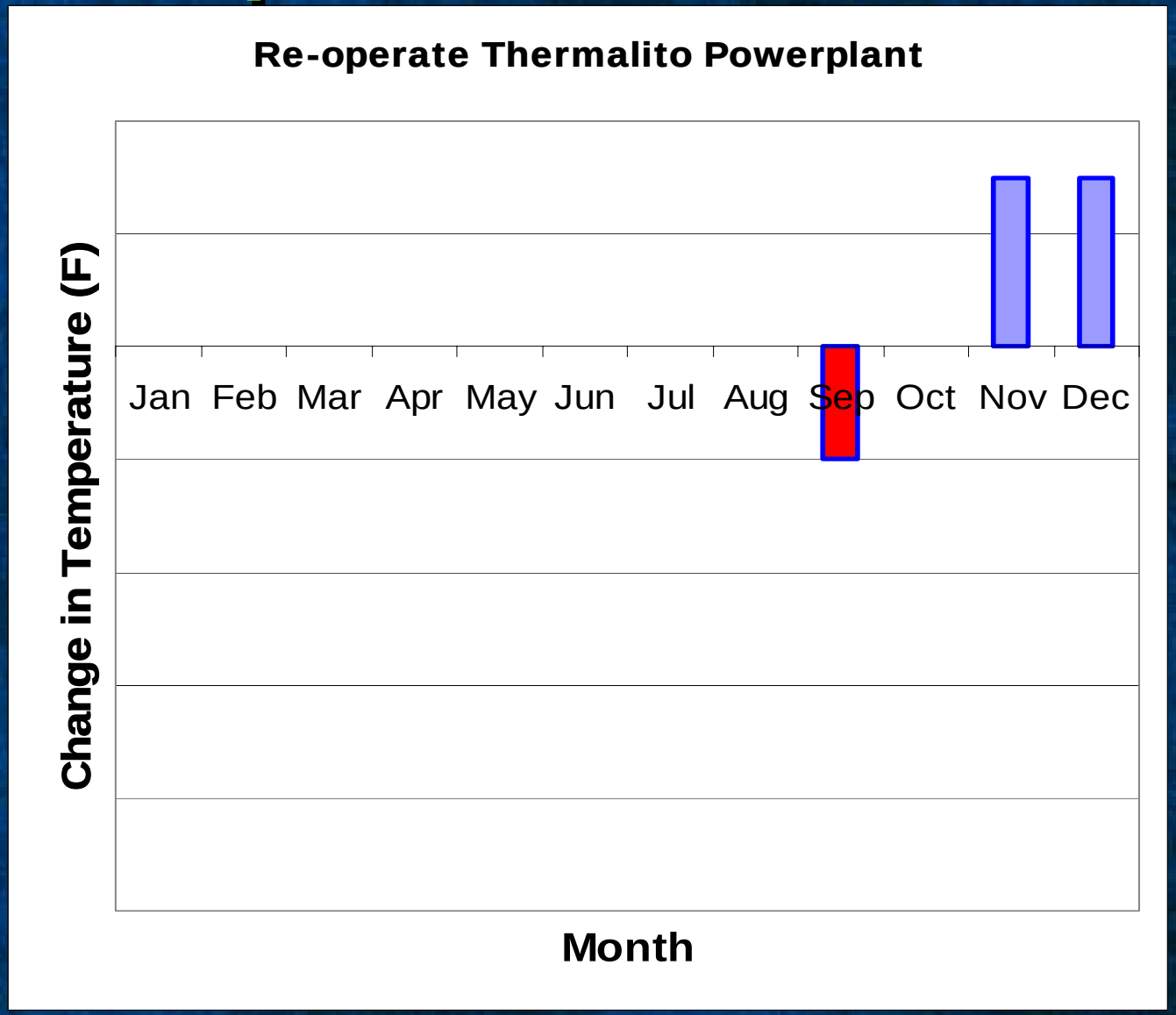
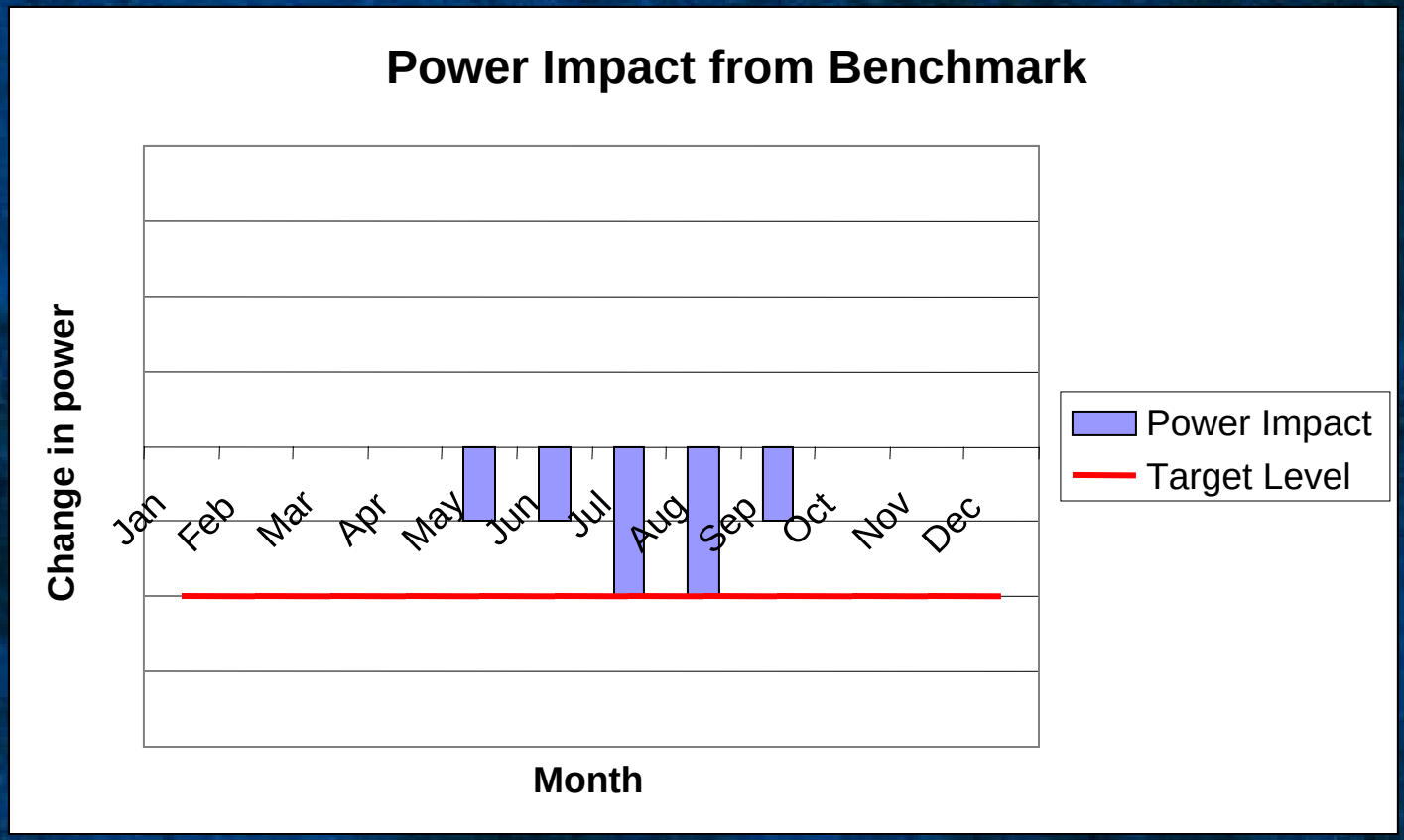
Example: Re-operate Thermalito Powerplant

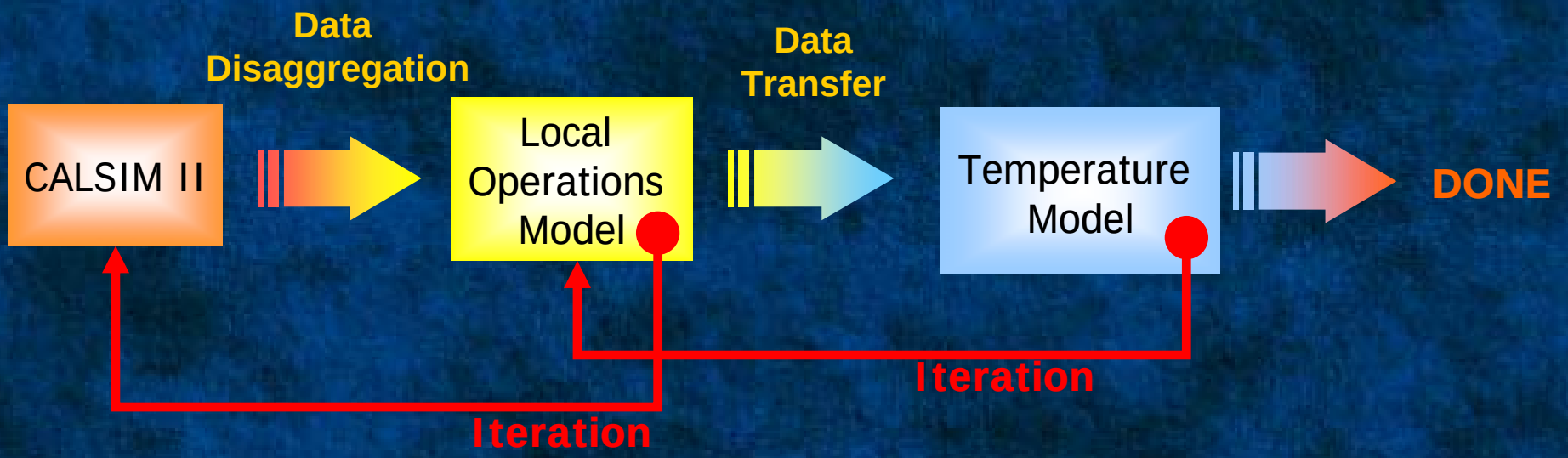


Example: Re-operated Thermalito Powerplant Results



Example: Models to use

- Increase total releases from Oroville

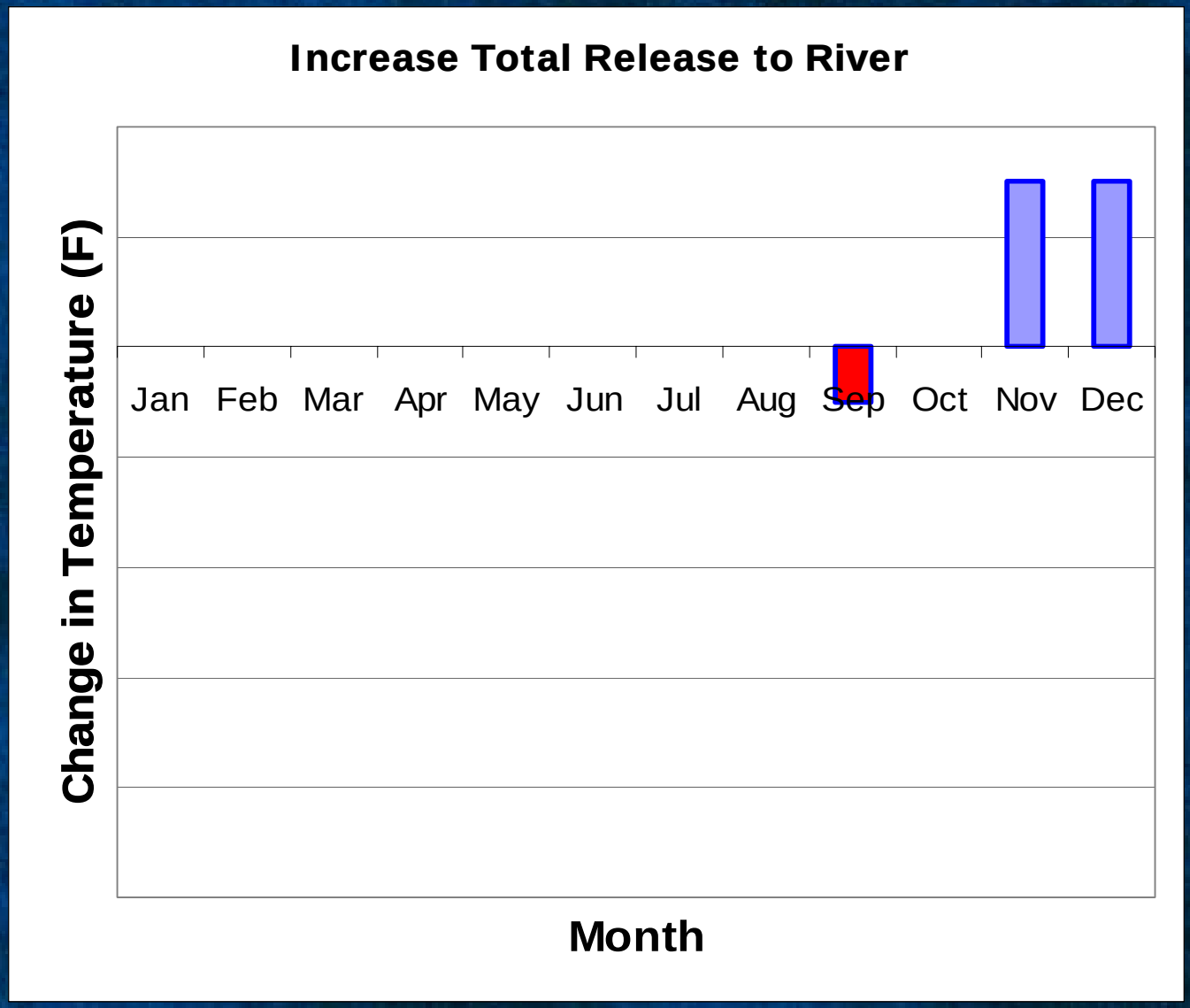


- Water supply conditions
- Monthly operations and water budget

- Power generation
- Hourly operations

- Reservoir temperature
- River temperature

Example: Results of Oroville Facilities Re-operation



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Q&A (Panel Discussion)

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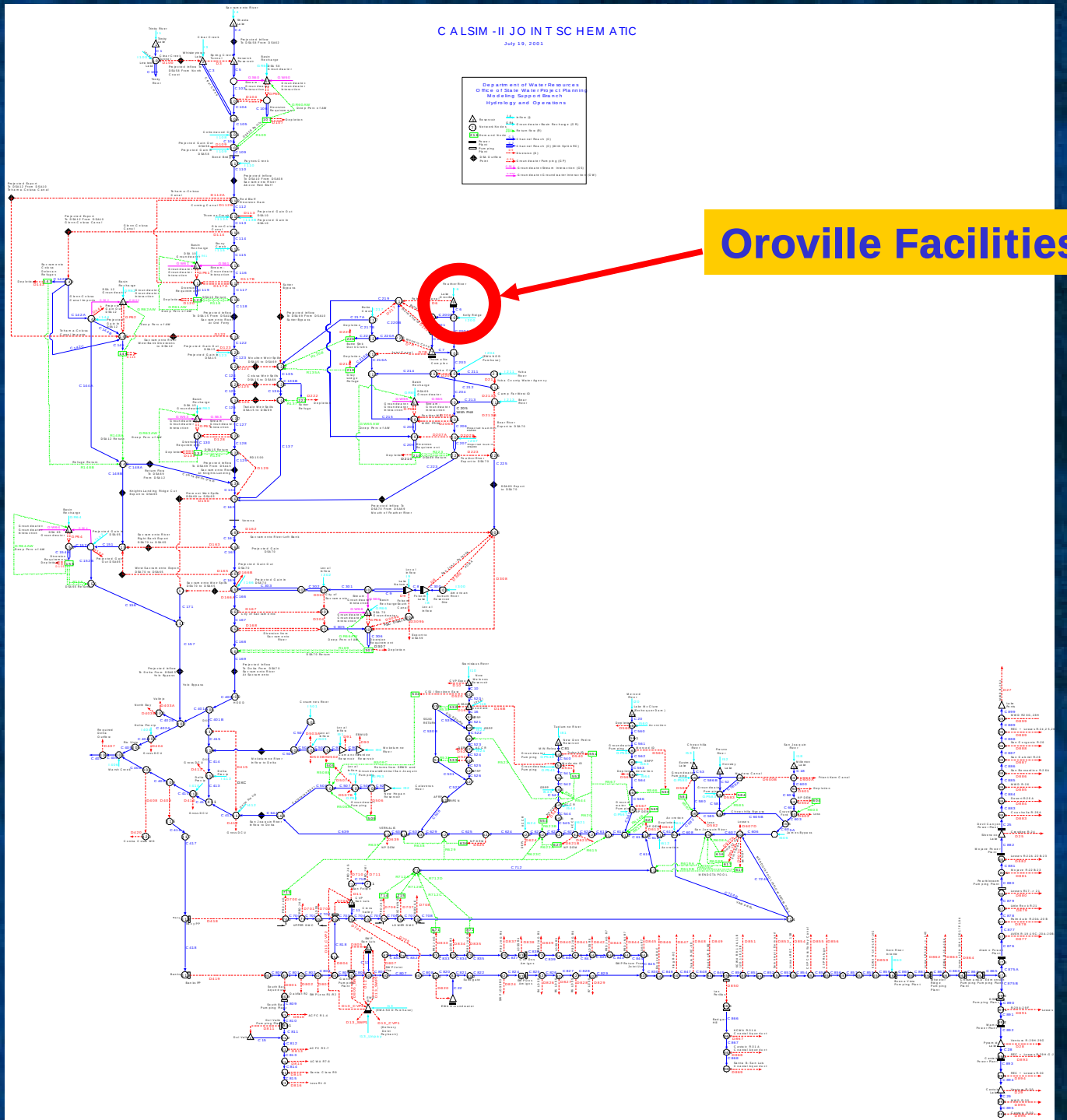
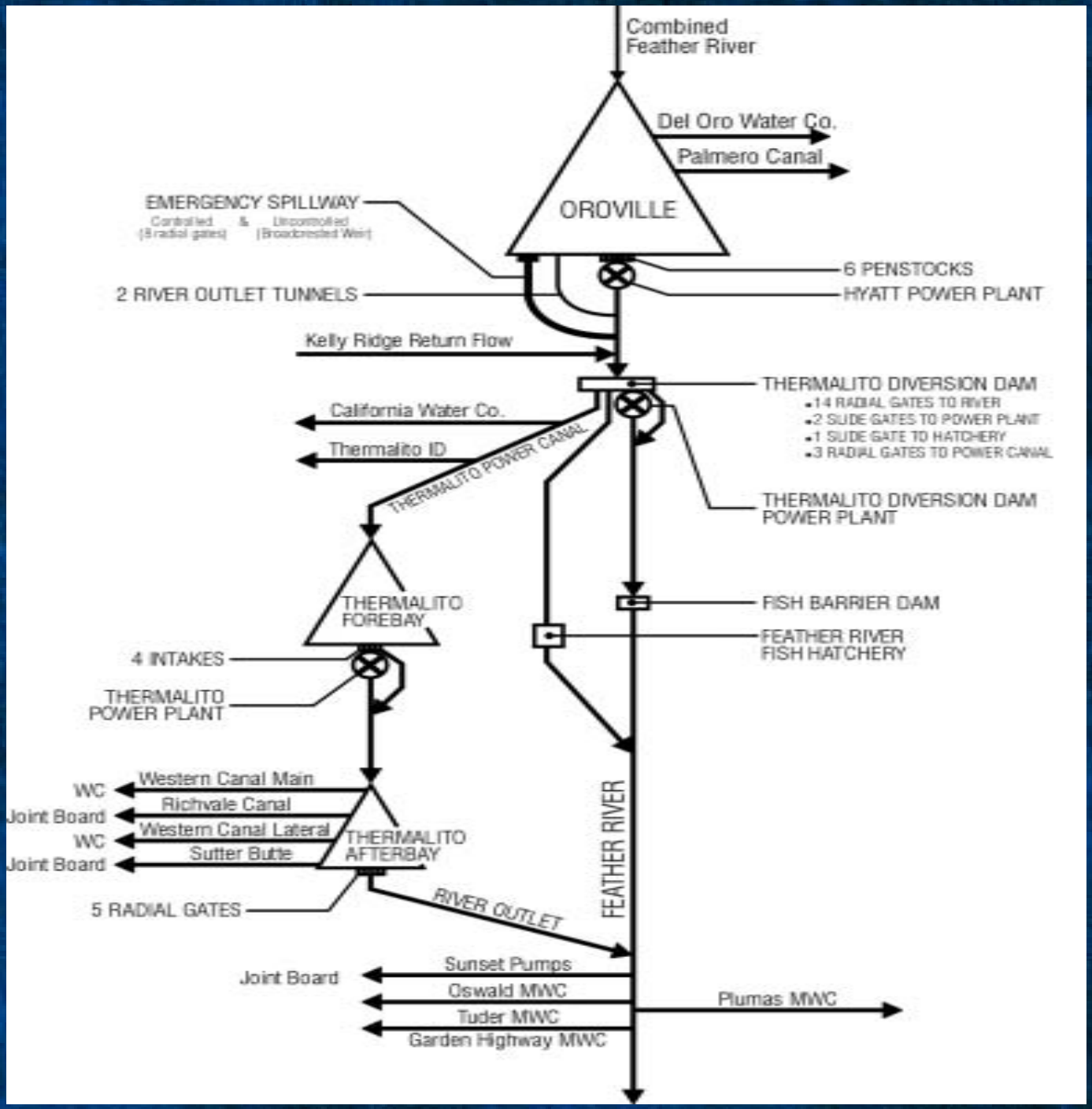

CALSIM-II JOINT SCHEMATIC
July 19, 2001
Department of Water Resources
Office of State Water Project Planning
Modeling Support Branch
Hydrology and Operations
Oroville Facilities

Back


Combined
Feather River
Del Oro Water Co.
Palmero Canal
OROVILLE
EMERGENCY SPILLWAY
Controlled (8 radial gates) & Uncontrolled (Broadcrested Weir)
6 PENSTOCKS
HYATT POWER PLANT
2 RIVER OUTLET TUNNELS
Kelly Ridge Return Flow
THERMALITO DIVERSION DAM
•14 RADIAL GATES TO RIVER
•2 SLIDE GATES TO POWER PLANT
•1 SLIDE GATE TO HATCHERY
•3 RADIAL GATES TO POWER CANAL
California Water Co.
Thermalito ID
THERMALITO POWER CANAL
THERMALITO DIVERSION DAM POWER PLANT
THERMALITO FOREBAY
FISH BARRIER DAM
FEATHER RIVER FISH HATCHERY
4 INTAKES
THERMALITO POWER PLANT
Western Canal Main
WC
Richvale Canal
Joint Board
Western Canal Lateral
WC
Sutter Butte
Joint Board
THERMALITO AFTERBAY
5 RADIAL GATES
RIVER OUTLET
FEATHER RIVER
Joint Board
Sunset Pumps
Oswald MWC
Tuder MWC
Garden Highway MWC
Plumas MWC

Back